RECEIVED
FEB 2 9 1904

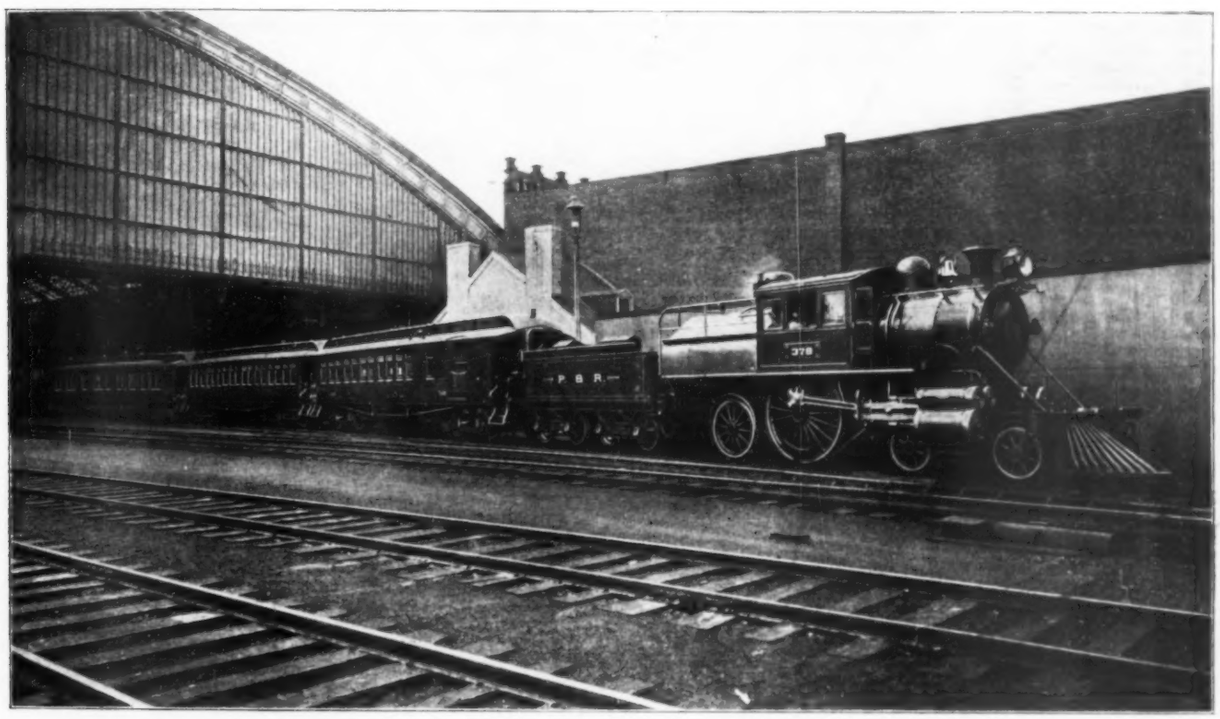
POPULAR MECHANICS

An Illustrated Weekly Review of the Mechanical Press of the World

"Tells you how to do things" Written so you can understand it

Vol. 4. No. 1. CHICAGO, JULY 4, 1903. PRICE 5 CENTS.

America Copies English Type of Locomotive



Eastern Road Amazes Experts By Adopting British "Two Driver" Engine in Preference to American Styles

IN THIS ISSUE:

America Copies English Type of Locomotive.
5,000-K. W. Vertical Steam Turbines.
Fourth of July Lockjaw.
How the Carnegie Steel Co. Became Great.
Millionaires Should Found Boat Clubs.
Fishing at Naples.
A Modern Summer Cruiser.
Pride Building of the World's Fair.
The Paris-Madrid Motor Car Race.
History of the Reed Organ.—Part I.
Portland's Splendid Harbor.
New Way to Refine Copper.
Largest Battleship Afloat.
Latest Theories of Radium.
Easy Electrical Experiments—A Portable Voltmeter, Part III.
Through a Modern Pipe Foundry, Part I.
Singing Into a Phonograph.
Shop Notes: How a Gasoline Engine Was Made From an Old Steam Engine—Relative Travel of Locomotive Crank Pin—How to Make a Machinists' Soap—Hardening and Tempering Steel—Cheap and Serviceable Pipe Covering—Welding Metals to Form Plate Metal—Vest Pocket Blow Torch—Multiplex System of Oiling.
Simple Device to Prevent Street Car Accidents.
A New Cooling Stove.
A Home-Made Cooking Box.

LIBRARY OF CONGRESS

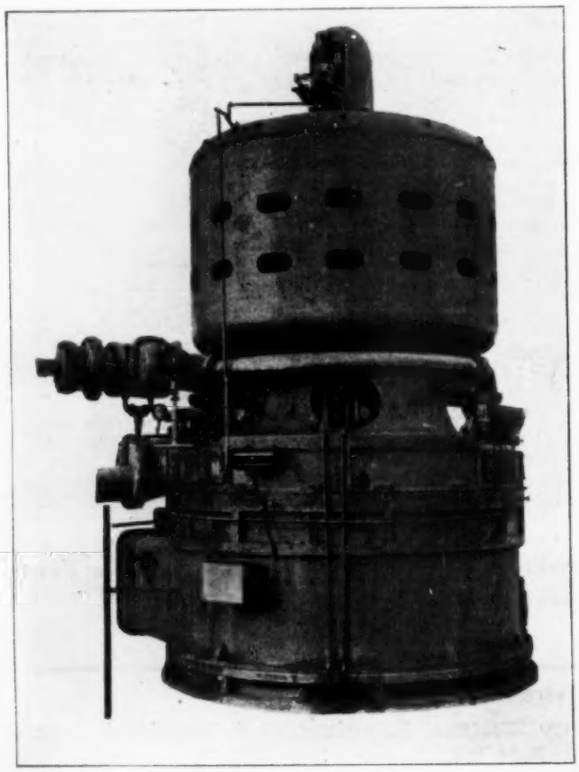
English Type Locomotive in America

Philadelphia & Reading Imitates the British in New Trains Between New York and Philadelphia

It is not often that American railroads imitate the English, but such has been done on the Philadelphia & Reading. That road has placed in operation a type of locomotive having a single pair of driving wheels, such as is commonly used in England for high speed passenger service. With the increase weight of rail, which is now being largely introduced, it is possible to obtain with this type sufficient tractive power without overloading the axles, to handle a train of from four to six cars, on a grade not exceeding one per cent. The front page illustration is from a photograph of a Philadelphia and Reading train, taken at the Reading Terminal, Philadelphia. Two of these locomotives are in hourly service on the road between Philadelphia and New York, making the regular schedule time. Ordinarily this train consists of one combination baggage and smoking car, one day coach and one parlor car.

5,000 K. W. Vertical Steam Turbines

A great steam turbine standing nearly 30 feet in height, and capable of developing 5,000 killowatts will soon be in operation at one of the electric light plants in Chicago. Other similar machines will follow a few weeks later. The Western Electrician thus describes the turbine which is known as the Curtis, and is a "two-stage" turbine: After the steam is expanded in the nozzle, and subsequently the velocity abstracted by successive impacts with buckets on the



Curtis "Two-Stage" Turbine

first wheel, the steam passes through another set of nozzles and the process is repeated. Excessive peripheral speed is thus obviated, as there is no longer a necessity for moving the buckets at one-half the velocity of the jet, a necessary condition for attaining the highest efficiency with a single set of buckets. A factory view of the first of these units is shown in the picture.

In the "Chicago units," as they are at present being called, there are three sets of buckets on each of the two wheels corresponding to the two stages. The size and arrangement of buckets are so proportioned for the particular rotative speed that the velocity is only partly taken out in the first stage, and what remains is practically all abstracted in the second stage. So low is the velocity of steam after leaving the second stage that the exhaust opening was made as large as possible, and the surface condenser placed almost against the side of the turbine.

The governing is done by successive closing of nozzles, provision being also made so that each nozzle can be closed gradually in regular sequence and can be worked continuously at any position between full open and closed. The governor itself is the uppermost part of the unit, being located on top of the alternator and connected to the end of the shaft. The steam consumption of these turbines is expected to be, under full load, somewhat better than that which can be secured from the best compound, condensing engines of the same capacity under test conditions. On account of the turbine having practically a straight-line economy, the steam consumption under actual operating conditions should be very much better.

In exterior dimensions the turbine unit is about 26 feet high and 16½ feet in diameter. It sets on a foundation about four feet above the floor, so the total height of the unit above the floor is 29 feet.

FOURTH OF JULY LOCKJAW.

Even Small Powder Wounds Should Be Thoroughly Cared For

The glorious Fourth of July might well be named "Lockjaw day." More fatal cases of tetanus or lockjaw are caused on this day than during all the rest of the year. And strangely enough, it is largely the result of small and apparently trivial accidents and wounds. The Journal of the American Medical Association sounds a warning and states that the blank cartridge is the most to be feared. The Journal says:

"Although there are plenty of other wounds received at this time each year, still the blank cartridge causes nearly all the tetanus infections. It is rare, indeed, that the lacerations from the exploding giant cracker are followed by tetanus. That this is not due to any infectious nature of the blank cartridge itself has been abundantly shown; repeated examinations have demonstrated that they are free from virulent tetanus germs. There can be no doubt that their danger lies in the nature of the wound they produce and the circumstances under which the wound is received. Street dirt is a favorite habitat of the tetanus bacilli or their spores, and the hand that receives the wound is usually well covered with dirt at the time of the accident. The wad carries this dirt, with its contained organisms, deep into the hand, where the ideal anaerobic conditions exist, even excelling those of the famous nail wound of the foot. In proportion to the number of wounds received there can be no doubt that the blank cartridge wounds are far more deadly than the nail wounds, for they are certainly less common, yet they cause about as many deaths.

"We should not forget that most of these deaths are preventable if the blank cartridge wounds are properly treated as soon as they are received. A thorough surgical treatment of blank cartridge wounds would save many lives every year."

"Static discharges" in electric circuits supply a very interesting and instructive example of one of the most universal of nature's methods—wave motion.

Nearly everybody likes Popular Mechanics.

How The Carnegie Steel Company Became Great

Co-Operative Plan Brought Out the Geniuses and Gave the Workmen a Chance

By Andrew Carnegie

Speaking from experience, we of the Carnegie Steel Company had not gone very far into manufacturing before discovering that perfect management in every department was needed and that this depended upon the men in charge. Thus began the practice of interesting the young geniuses around us, as they proved their ability to achieve unusual results—the source of big dividends. These received small percentages in the firm, which were credited to them at the actual cash invested, no charge being made for good-will. Upon this they were charged interest, and the surplus earned each year beyond this was credited to their account. By the terms of the agreement three-fourths of their colleagues had the right to cancel it, paying the party the sum then to his credit. This provision was meant to meet possible extreme cases of incompatibility of temper, or of the recipient proving incapable of development or of enduring prosperity. At death the interest is reverted to the firm at its book value. The young men were not required to assume any financial obligation, and not until their share was fully paid by the profits, and there was no further liability upon it, was it transferred to them. Thus thoughts of possible loss never prevented concentration upon their daily duties. They were not absorbed in the daily quotations, for the shares were not upon the Stock Exchange or transferable. This policy resulted in making some forty-odd young partners, a number which was increased at the beginning of each year.

By this plan they were rapidly paying for their interests and promising to become the millionaires of the then seemingly somewhat distant future, which, however, proved not so very distant. They are now rich men.

We did not fail to see, as the works enlarged, how much success depended upon the mechanical men, the superintendents and foremen, yet not one of these had up to that time been admitted as partner. The business and the mechanical men—office and mill—were still widely separated. Well do I remember the first attempts to bring these two departments into closer relations. It was made with our Captain Jones, perhaps the foremost manager of his day in America. He came to us as a working mechanic at $2 per day. I explained to the captain how several of the younger men in the business department had been made partners and were actually receiving much greater rewards than he, while his services were at least equally valuable, and informed him that we wished to make him a partner. I shall never forget his reply. "Mr. Carnegie, I am much obliged, but I know nothing about business, and never wish to be troubled with it—I have plenty to trouble me here in these works. Leave me as I am, and just give me a thundering salary." "Hereafter," I said, "the salary of the President of the United States is yours, Captain," and so it remained till the sad day of his death. My seniors, the presidents of the other manufacturing concerns, did not fail to take me to task for ruining the steel business by paying a mechanic more salary than any of them received. Being much the youngest of these great dignitaries, I humbly confessed my wrongdoing, not, however, failing to inquire if they knew where we could find two or three more Captain Joneses at double the price. We did not overpay the captain; he was worth several ordinary salaried presidents. The captain's refusal of partnership was the only one which ever came within my experience. None of the other mechanics ever preferred salary to partnership; and they were wise. Nothing can compare with that form. From that time forward the union of the mechanical and business partners went steadily forward until no manager of a mill was without his interest in the business, as pertaining to the position, and no board of management or important committee was without a mechanical representative. Thereafter mill and office conferred upon all important sales and contracts. The mechanic and the man of affairs were in constant consultation and fellow partners—one of the most profitable changes that we ever made.

Millionaires Should Found Boat Clubs

Endowing Libraries and Beds in Hospitals Not the Best Means of Aiding Humanity

By Constance S. Titus, Champion Oarsman of America

If those wealthy men who are in the habit of donating a public library or two before each breakfast, or who endow a few beds in their favorite hospitals every other day, would pause a moment to consider the inestimable blessings of physical culture, and especially rowing, they would, I venture to say, found a few boat clubs during the course of each year. Exercise means physical culture, and physical perfection reduces to a minimum the necessity for hospital beds. Libraries are all right to train the mind and improve the idle hour, but the mind can never be healthy without a healthy body.

There will always be many opinions as to what is the superior method of training the body and acquiring a desirable degree of gymnastic perfection. But neither the sprinter, nor the wheelman, nor the walker, nor the golfer can say, that rowing has an equal as a generous distributor of exercise. It has somewhat of a rival in swimming, which really brings every muscle into play, but which is too exhausting to the vitality; and boxing, too, is a sport to send the blood through every vein.

But rowing, above all, and by rowing I mean the correct way of manipulating the sliding seat and the oar, benefits legs as well as body, arms as well as mind. The millionaire who will remember rowing in his gifts will be the world's surgeon, and will straighten crooked spines and deformed limbs, and reconstruct puny frames that even the public reading-rooms and private hospitals, with all their salubrious effects, cannot remedy or make right.

FISHING AT NAPLES.

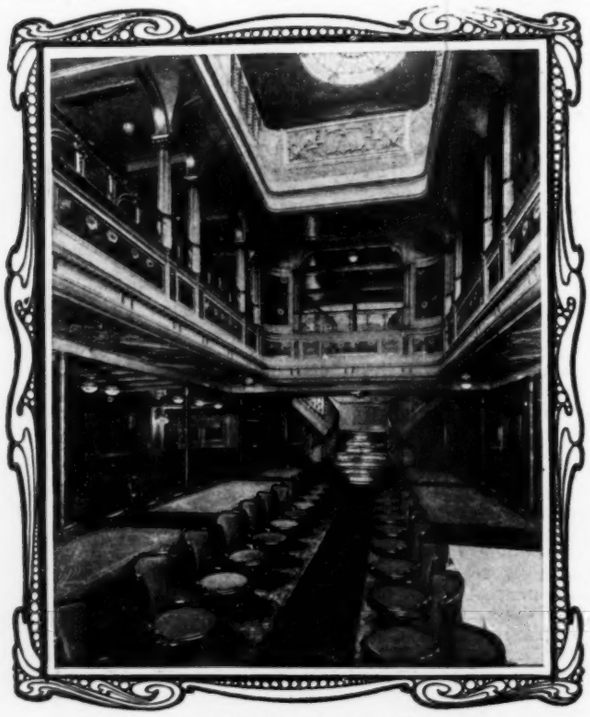
Scenes That Attracted King Edward During His Visit

Fishing is one of the principal industries of the city of Naples. The unique methods employed by the fishermen was a source of great amusement to King Edward during his recent visit to that picturesque city and during a leisure hour he stole away to watch the boats come in after the day's catch. The scene in the Bay of Naples as it appeared when the king looked on is shown in the accompanying illustration.

Fishermen's Boats Being Towed in by Tugs at Naples

A Modern Summer Cruiser

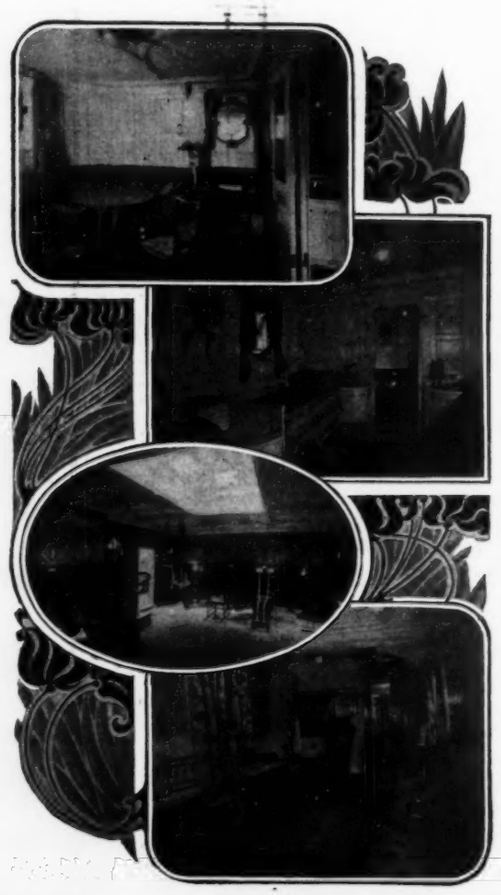
The twin-screw steamer, Prinzessin Victoria Luise of the Hamburg-American line, is one of the new floating palaces



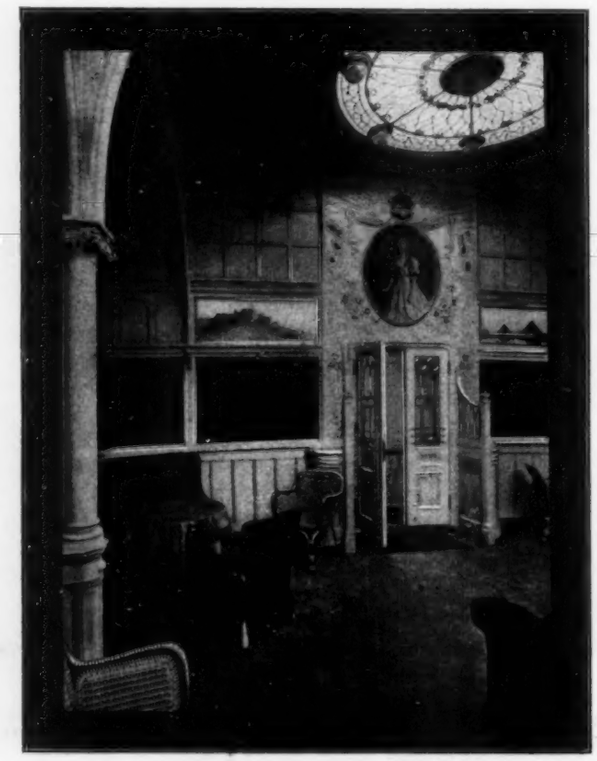
Dining Room Steamship Prinzessin Victoria Luise

designed for cruises in the far north during the heated summer months. These vessels are fitted out with every convenience and luxury that modern human beings could desire, and a trip to the Land of the Midnight Sun is now made with as great ease as a visit to Niagara Falls or Colorado Springs.

While the graceful lines of the steamer conform to the idea of a yacht, her dimensions are those of an ocean vessel, her length being 450 feet, width 47 feet, and depth 30 feet. The entire space of the vessel, except what is occupied by engines and crew, is devoted exclusively to first cabin passengers. The staterooms are cheerful in appearance and homelike in equipment. They contain lower berths only. There are also single-berth rooms for the exclusive use of one passenger each. Choice suites, with private baths and toilets are



1 and 2. One of the Suites, Consisting of Parlor, Bedroom, Bath and Toilet. 3. Gymnasium. 4. Stateroom



Entrance to Social Hall, S. S. Prinzessin Victoria Luise

also provided. With reading rooms, smoking rooms, social hall, gymnasium, promenade decks, excellent meals and luxurious staterooms, the tourist on a summer cruising vessel need certainly lack nothing in the way of enjoyment. The accompanying illustrations will give our readers an idea of the equipment of an up-to-date vessel.

All leading British manufacturers were so utterly "full-up" of profitable work that they were absolutely unable to take any more for two years or so. This is the sole reason why the Midland, Great Northern, Great Central and New Zealand contracts for locomotives went to America.—Page's Magazine.

British builders ought to enlarge their plants.

In London the climate is so variable a dealer in photographic supplies finds it attractive to post each day in his window the length of time exposures should be made for street snapshots and kodak films.

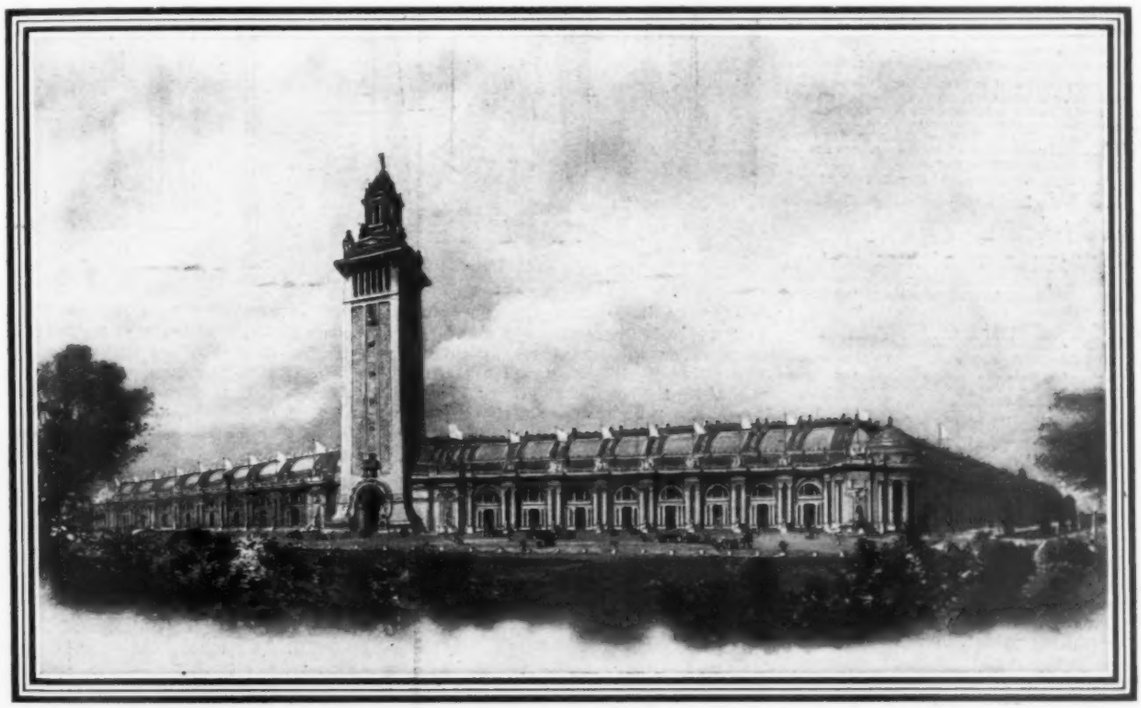
Some people say Popular Mechanics is the best paper published.

Pride Building of the World's Fair

Exposition's Home of Manufacturers to be Its Most Magnificent Structure

Costing nearly a million dollars, representing the acme of the architect's skill, and located on the most conspicuous site of the exposition grounds, there will be no more beautiful construction at the St. Louis World's Fair, than the Manufacturers' building. It will be located symmetrically with the Varied Industries building and both will be in the first view of the picture of lagoons, cascades and hanging gardens which the visitor will get as he enters the exposition grounds by the main entrance. At the northern end of each structure a gigantic tower 400 feet high will be reared. Isaac S. Taylor, chairman of the commission of architects of the World's Fair, writes:

The manufacturers' building is a noble composition developed in the Corinthian order of architecture. It lies in the main picture, being one of the buildings on the entrance to the main boulevard or central spacing. The structure has a frontage to the north of 1,200 feet, with a depth of 525 feet on the main boulevard. The architects have de[illegible] and imposing entrances at the centers of the main facades and have composed a tower some 400 feet high to stand at the angle of the main facade facing north. This prominent feature gives an appropriate balance with a tower of corresponding height on the Varied Industries Building immediately west. These two towers will balance the main front of the general layout of the important buildings constituting the Fair.



Manufacturers' Building

The Paris-Madrid Motor Car Race

Future Tests Prohibited by the Government -- Ninety Miles an Hour.

The great race of motor vehicles between Paris and Madrid, a distance of 342 miles, resulted in the death of eight people, and numerous accidents. It will not be repeated as the government has prohibited any more such races. Now that the dust has settled, the dead buried, and the fragments of scores of demolished machines cleared away, it is interesting to note what was really accomplished.

Two hundred and sixteen motor vehicles started out in the race, which began at 3:30 in the morning. Soldiers had been stationed all along the route to keep spectators out of danger; but they gathered by hundreds of thousands and could not be suppressed. Thousands stood all night in order to hold a good location for the next day. The drivers declared they felt as if they were driving against solid human walls which opened out to let them pass. One driver in trying to avoid a dog ran into a tree, killing one person, hurting several and smashing his machine to atoms.

There were several machines with 90 horsepower, one of 110 horsepower, and scores of 40, 60 and 70 horsepower. In order to keep within the limit of weight, which was about 2,000 pounds, holes were bored in floors, seats, and every bit of metal which could be spared was removed. Many of the car bodies were made of aluminum. In most cases the engines were nearest the front wheels, leaving only a small weight to balance the rear, and in turning curves several cars were overturned. To the surprise of all the big cars with the greatest power did not show as good results as the smaller ones with 40 or 60 horsepower. The big cars made at times a speed of 90 miles an hour, but were unable to stand the strain. The Engineer, of London, says: "The most striking thing about the race was the failure of the big cars, though the victory of Gabriel on his 70 horsepower Mors, which covered the 342¾ miles in 5 hours 13 minutes, representing an average of about 66 miles an hour, is proof enough that the increased power means a higher speed, if only the vehicle can get safely over the course. The 30 horsepower light Renault car, only took 19 minutes more than the big Mors to cover the course. With such a small difference it can hardly be said that these huge engines have shown up to any advantage. Still more convincing proof of the failure of the big engines is seen in the fact that the 90 horsepower Mercedes were beaten by the 60 horsepower vehicles of the same make, and both of the same weight, so that here again reliability came out absolutely victorious."

The gasoline motors had decidedly the best of the races, only two steam vehicles making the entire course.

Popular Mechanics is written so you can understand it.

Popular Mechanics

"Written So You Can Understand It"

PUBLISHED BY POPULAR MECHANICS CO.
JOURNAL BUILDING .. .. CHICAGO

H. H. WINDSOR, President
R. R. RUTHERFORD, Sec'y H. A. HESS, Treas.

SUBSCRIPTION

United States, Canada, Mexico and all U. S. Possessions, per year $2 00
Foreign Countries, post paid 3 00

Subscribers are requested to give 10 days' notice in advance when change of address is desired. Doing this will insure their receiving the paper without interruption. Be sure to give old address as well as new.

Advertising forms will close Tuesday at 5 p. m. for issue dated Saturday of the following week. Advertisers are invited to examine our books at any time.

Make Remittances by Draft, Money Order, or Registered Letter. Address

POPULAR MECHANICS
Journal Building .. .. Chicago

Entered at the Chicago Postoffice as Mail Matter of the Second Class.

LONG DISTANCE TELEPHONE MAIN 2682

DETERIORATION OF LEATHER.

A very striking instance of the deterioration of leather produced under conditions demanding quicker tanning by the use of various chemicals, thus decreasing the durability of the material, is afforded by the fact that the British Museum expends $20,000 a year in rebinding books in leather. Modern leather, says the Scientific American, is entirely different from the material produced by what is now regarded as an effete process, its life being limited to fifteen years. In the search for cheaper and quicker processes of making leather, large quantities of sulphuric acid are used, and this substance, in combination with others, causes the material to decompose rapidly in the course of a few years.

RECIPE FOR BLUE PRINT SOLUTION.

One of our readers, whose address we have unfortunately mislaid, sends us the following recipe for blue prints, which he has used with much satisfaction. The same formula may be employed for postal cards on which it is desired to print landscapes and similar views.

Make a solution as follows:

Water .....3 oz.
Ammonia Citrate of Iron.....300 grains
Oxalate of Potash ..... 75 grains

Dry in the dark, print and then develop in the following:

Water .....3 oz.
Nitrate of Silver..... 15 grains
Citrate of Soda.....150 grains

Ammonia to dissolve precipitate.
Acetic acid till slightly acid.
Wash slightly and dry.

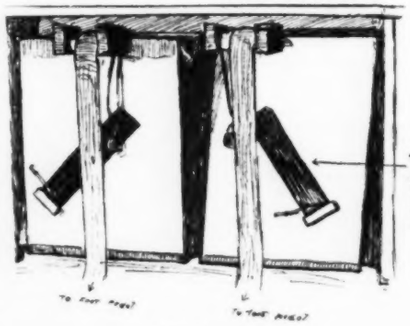
SCARE-CROWS ON ROOF.

A new use has been found for scare-crows at Victoria, B. C. Continuous leaking of the slate roof of a large building led to the discovery that crows were the cause of it. The birds which swarm on the beach and dig for clams, it was found, would fly over the building and drop the clams on the roof, by this means breaking the shells and leaving the meat free to be eaten. In many cases when the clams were dropped, the slate would be broken. Now scare-crows have been placed on the roof to keep the birds away.

History of The Reed Organ--Part I.

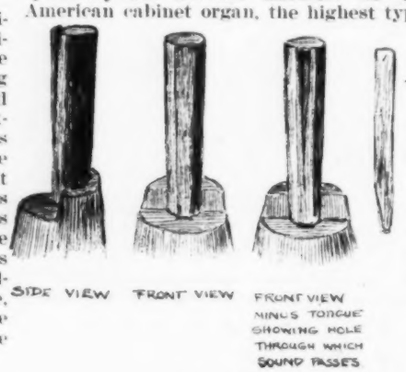
From the Presto, by Henry Lowell Mason

The evolution of the reed organ may be traced back to two hundred years before Christ. Probably the Greek "Oraganon," was the first of the type. The Pipes of



Double Bellows

Pan and a little later the more humble bagpipe and accordion, all of Greek origin are representatives of this type. The Bibel-Regal of the 17th century is probably the earliest ancestor of the American cabinet organ, the highest type

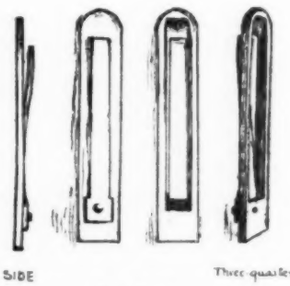


Beating Reed

of this class of instrument. This instrument employed beating reeds. It was provided with two bellows connected with the wind chest so arranged as to appear like the cover of a book, from which fact it took the name of "Bibel." One hand only of the player was free for the keyboard as the other hand was necessary to pump the bellows. Bibel-Regals enjoyed a certain popularity in their day, especially in the home, for at that time the only instruments were the great pipe organs, and these were confined to churches and cathedrals.

In the 19th century the Kleine-Physharmonica, an instrument employing keyboard and free reeds, appeared and produced a tone similar to that of the mouth harmonica, an instrument of no real musical value. The use of free reeds instead of beating reeds marked a decided advancement in construction as never before had the free reed been employed in an instrument by means of key-board.

Known from an early time in China, but greatly developed in 1810 by a Frenchman named Grenie, the free vibrating reed consists of a brass plate containing an oblong slit, with a thin, elastic tongue or vibrator made fast at one end in such manner and so exactly fitting into the slit as to close it; but so fitting that it will bend to pressure of wind at the free end, passing either upward or downward without touching the sides or the free end. The distinctive difference between this form of reed and the beating reed used in Bibel-Regals, and universally used in pipe organs, is that in the latter the tongue covers the entire orifice,



Free Reed

and in vibrating does not go downward through the opening. The advantages of the free over the beating reed are many; for instance, the tone is of a more agreeable quality; the free reed necessitates no pipe, thus demanding less space than the

Harmonica

beating reed; the free reed is far less liable to go out of order, and it renders possible a most important property, namely, the power of expansion.

GREAT LAKES FLOATING IN THE CLOUDS.

Not one person in ten thousand has any conception of the floods of water which go coasting overhead in the form of clouds. It is only when some unusual downfall in the shape of a cloud burst, or continued rainfall, that we stop to give the matter any thought. During a rain most of the water sinks into the ground and a large amount evaporates into the air. What remains finds its way into the creeks and rivers.

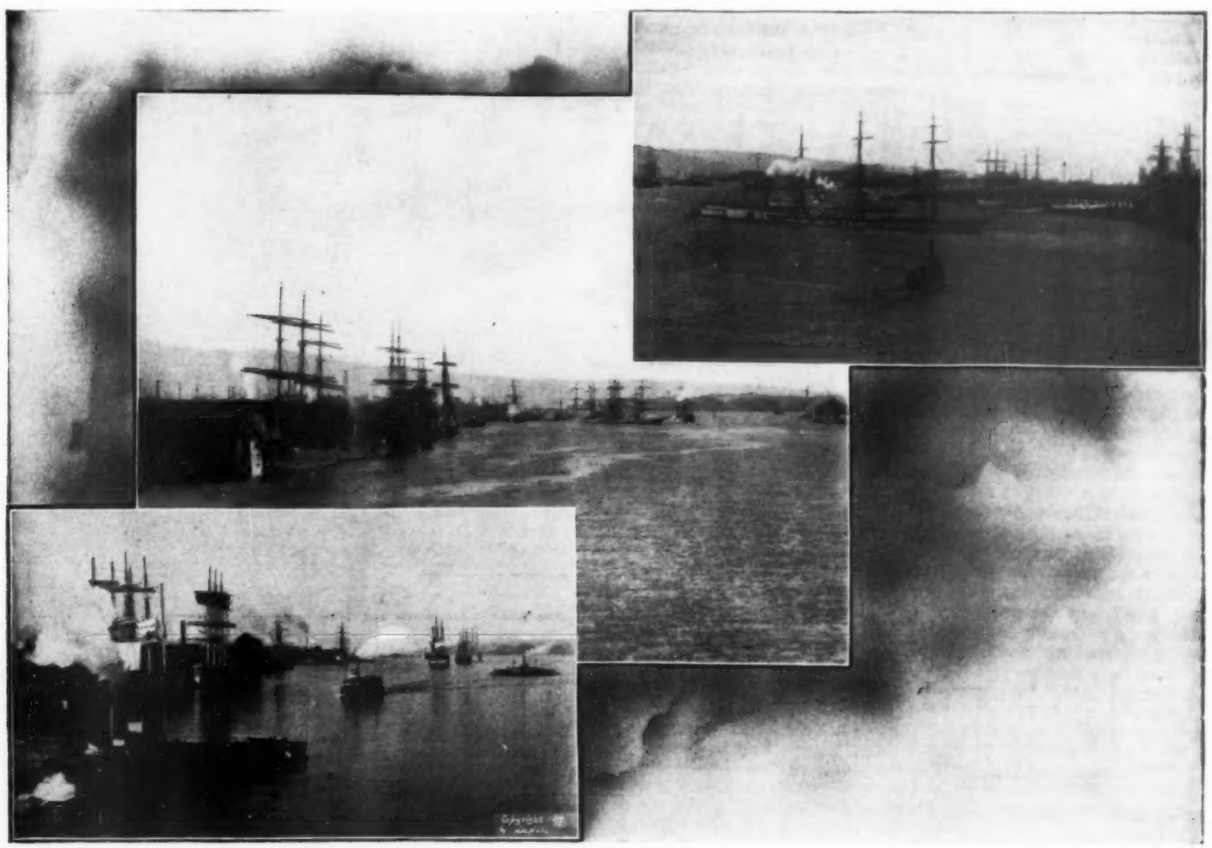
A precipitation of two inches is heavy but by no means unusual. An exchange has calculated what this would amount to in the way of a river if it should be drained quickly into the lowest part of a valley. If the valley were fifty miles wide and two hundred miles long, a rain fall of two inches would produce a river the full length of the valley, two hundred miles, a mile in width and of an average depth of eight feet. Imagine a series of rains aggregating six inches instead of two, in a drainage basin five hundred miles long and two hundred miles wide. Under such conditions, if it were not for the checks upon immediate drainage into the central stream by which the surplus finds its way to the sea, there might be created a lake five hundred miles long, four miles wide and twenty-five feet deep.

The lock to be placed in the Danube-Oder canal will be 131 feet high and the highest in the world. The Austrian minister of commerce has offered big prizes for the best plans for it.

Portland's Splendid Harbor

Fresh River Water Cleans Vessels of Barnacles While They are in Port

Many old time seamen declare Portland, Ore., to have the finest harbor in the world. Vessels coming in from the Pacific ocean with their hulls covered with barnacles are thoroughly cleansed while remaining in harbor by the fresh waters of the river without the necessity of having their bottoms scraped. This saves thousands of dollars a year to seamen. Besides, the harbor is most admirably formed for the movement of vessels. Such a harbor gives Portland a splendid advantage in the competition for the greatly increasing ocean traffic of the Pacific ocean.



Scenes in the Harbor at Portland, Oregon

New Way to Refine Copper

Two Cornell Students Discover Method That May Save Millions

Two students of the engineering department of Cornell have made a discovery that will probably work a great change in present methods of refining copper throughout the world. Joseph Schwab of New Orleans and Isaac Baum of Uniontown, Pa., are the discoverers. They demonstrated that the temperature at which copper is now refined and the current which passed through the refinings vats are not high enough. By using the temperature and the current density which the students have calculated, it is claimed, the original cost of a refinery will be reduced one-half.

"All that I will say at present," declared Baum, "is that I believe all the refiners in this country will soon use our method."

The two young men explained their discovery in a thesis on which they collaborated. They received a mark of 98 per cent on their treatise, the highest in the history of Cornell.

Professor Wilder D. Bancroft, under whose supervision Baum and Schwab have been working, will translate the thesis into German and it will be read before the Electro-Chemical society of Berlin. At this meeting the details of discovery will be explained in full.

About $80,000,000 worth of copper is refined in this country annually and $12,000,000 worth of silver and $4,000,000 worth of gold are recovered therefrom. The present cost of refining is $5 a ton.

LARGEST BATTLESHIP AFLOAT

Commonwealth, the New British Monster, Recently Launched at Clyde

The monster British battleship Commonwealth which was regently launched on the Clyde, is one of four sister ships of the so-called "King Edward VII class," now under construction for the British government. The Commonwealth is the largest battleship afloat, with a displacement of 16,500 tons; extreme length, 440 feet; width, 78 feet, and depth, 26 feet 9 inches. Her fighting strength will be 755 men, four 12-inch, four 9-inch, ten 6-inch, eighteen 3-inch and six 3-pounder guns and four 18-inch submerged torpedo tubes. Her armor is of the Krupp make, and varies from twelve-inch steel plates over her bulkheads, barbettes and conning tower, down to one and a half inch belt on deck and aft of the upper works. The required speed of this sea giant is 18.5 knots, supplied by two sets of four-cylinder, inverted, triple expansion engines, with 18,000 indicated horse power. The next largest war vessels are the Connecticut and Louisiana, now building for this country, and three others ordered of 16,000 tons displacement each, and six of like displacement planned by Russia. The latter are not under way of construction.

In shipbuilding Pennsylvania stands first and New York second, while California is a good third.

EASY ELECTRICAL EXPERIMENTS

By L. P. Dickinson

A PORTABLE VOLTMETER.—PART III.

It will be necessary to make some sort of a case to cover the working parts of our voltmeter in order to protect them from mechanical injury and to shield the pointer from currents of air. A very nice case may be made from a piece of smooth sheet copper cut in the proper shape and soldered wherever necessary. The general shape of the case is shown in Fig. 5, which also gives an idea of the appearance of the finished instrument.

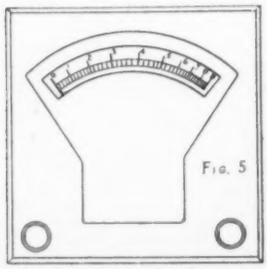


Fig. 5

The instrument as described may be used as a voltmeter or as an ammeter according to the method of connection. In either case, for the purpose of calibration, a standard instrument is almost necessary—that is to say, some instrument whose readings are known to be approximately correct. Let us suppose that our instrument is to be used as a voltmeter. The method of connection is shown in Fig. 6. Here A is the instrument described and B is the standard instrument, connected in parallel with A. A battery shown at C must be provided sufficiently powerful to deflect the needle to its fullest extent. An adjustable resistance shown at P will also be required. Insert in series with A, a coil of wire represented merely at R. This is to be made of the same sized wire as is wound upon the coils of the voltmeter, and is a loose coil of wire. The process of adjustment is as follows: Suppose it is desired that A should give a full scale deflection on 30 volts. Make connections as shown and adjust P until the standard reads at 30. Then insert enough resistance at R so that A will give the proper deflection. Probably this will cause a slight change in the reading of the standard so that P must be again adjusted. By alternately adjusting P and R the proper deflection of A will finally be reached. After this R is to remain unchanged and lower points upon the scale of A are obtained by adjusting P until the standard reads at the desired value when the position of the needle of A can be marked with a pen. After calibration the resistance R may be fastened inside the case of the voltmeter and connected in series with the coils. It is then out of the way.

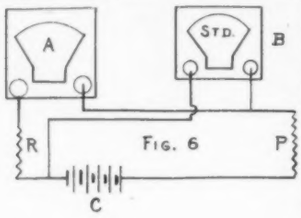


Fig. 6

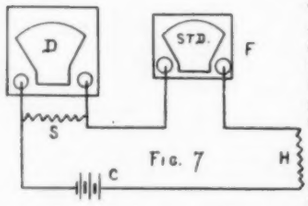


Fig. 7

Suppose, however, that the instrument is to be used as an ammeter. Then it will be necessary to connect across its terminals a low resistance as shown at S, Fig. 7. The instrument D is connected in series with a standard ammeter F, an adjustable resistance H, and a storage battery C. H is adjusted until the standard reads at the desired value when S is adjusted until D gives the proper deflection. This will cause a change in the reading of the standard, necessitating a readjustment of H and another adjustment of S. Having once fixed S, however, it is not to be changed. It can be soldered permanently to the terminals of the instrument and coiled up inside the case. The various points upon the scale of D may be obtained by adjusting H until the standard reads the proper value when the position of the pointer D is marked with a pen as before.

The instrument may, therefore, be set up either as an ammeter or a voltmeter and ought to be of considerable value to the amateur.

Sixty-seven sailings a month on first-class passenger steamships will be made from New York to European ports. This is provision for 86,000 passengers between April and September

THE GIANT "KAISER WILHELM II."

Can Carry 2,500 Persons and is the Third Largest Vessel Ever Built

The North German Lloyd steamer, "Kaiser Wilhelm II." is the third largest vessel and in many respects the most remarkable ship ever built. The illustration shows the enormous craft starting on her maiden voyage a short time ago from Southampton. She was built at Stettin. The steamer is 706 feet 6 inches from stem to stern and is exceeded in tonnage only by the "Cedric" and "Celtic" of the White Star line. Her speed is 23½ knots an hour. She can carry 775 first-class, 343 second-class and 770 third-class passengers with a crew of 600 or 2,500 souls in all.

"Kaiser Wilhelm II" Starting on Her Maiden Voyage

LATEST THEORIES OF RADIUM.

The leading scientists of the world are striving to find some satisfactory explanation of the mysterious energies possessed by radium.

In the Electrical Review, London, Sir William Crookes states his belief that the energy of radium is derived from the surrounding air. The radium is supposed to have the property of absorbing the energy of the high-speed molecules of the air, and thus raising its temperature above that of the surrounding air. Prof. J. J. Thomson fails to see that even the possession of the property would explain the behavior of radium; "for imagine," he says, "a portion of radium placed in a cavity in a block of ice; the ice around the radium gets melted; where does the energy come from? By the hypothesis, there is no change in the energy of the air-radium system in the cavity, for the energy gained by the radium is lost by the air, while heat cannot flow into the cavity from the outside, for the melted ice around the cavity is hotter than the ice surrounding it."

Prof. Thomson's theory is that the high-speed atoms become unstable and radiate part of their internal energy into space. It is believed by physicists that the velocity of the molecules of solids and liquids, like those of gases, are continually changing, owing to collisions. The mean velocity remains the same at constant temperatures, but the velocities of single molecules are continually rising above and falling below the mean. Thomson assumes that the internal constitution of the atom may become unstable when it attains a velocity, say 100 times the mean velocity. Under these circumstances the atom becomes partially disintegrated and throws off the positive and negative electrons which are known to be emitted by radium. The percentage of the total number of atoms which attain this high velocity, and become unstable, is always very small, but the number is sufficient to maintain the energy emitted by radium for 30,000 years if we assume that each atom loses only 1 per cent of its intrinsic energy.

Through a Modern Pipe Foundry--Part I

The Pit--The Flasks--Process of Ramming Molds--All as Described by Supt. Crocker of the Colorado Fuel and Iron Co.'s Works

By W. N. Crocker, Superintendent of the Minnequa Works, Colorado Fuel and Iron Co., Pueblo, Colo., and Contributor to Camp and Plant.

A visit to a modern foundry, making water and gas pipe is of much interest to those engaged in the casting of metals, as the large tonnage and quick handling of tools cannot but appeal to them.

The process of ramming molds is shown in the illustration. Damp molding sand is packed with a rammer into a flask around an iron pattern which is just the size of the pipe to be made.

Ramming Gang

The pit which is usually lined with stones is circular having a rectangular offset from one side to facilitate the ramming, and having at the end a large rectangular oven for drying the molds. The center of the pit which is built up to the level of the foundry floor, usually supports two cranes, one used principally by the casting gang, the other assisting the rammers.

The flasks (frames holding the sand, etc., forming the mold) are of iron, hinged vertically, and are single for large pipe. For smaller pipes, double, triple and sometimes quadruple flasks are used.

The empty flask is placed vertically on the ramming stool, where it is rammed up by hand, a straight pattern being used for the body, the socket being formed by a separate pattern. This pattern is withdrawn, leaving in the flask a cylinder of sand, which is the mold for the outside of the pipe. The inside of this mold is blacked, put in an oven and dried over night. The next day the flask is put in a molding pit and the core is placed perpendicularly inside the mold which is contained in the flask. Between the core and the mold is a space equal to the thickness of the pipe, and into this space the molten iron is poured. The heat of the iron ignites the straw covering the bar in the core, although a layer of adobe and sand separates the core from the iron. The core bar is then withdrawn, and the flask containing the newly made pipe is taken from the pit and the clamps knocked off. The pipe then drops out, is cleaned, tested and prepared for shipment.

Singing Into A Phonograph

Good Vocalists' Voices Often Sound Worst, Poor Singers May Make Good Records

By Thomas A. Edison

When a singer is up before an audience, he or she can tell whether the effect of the voice is pleasing or not by watching the countenances of the listeners.

When, however, one sings into a dead instrument like the phonograph, without the slightest recognition as to whether the voice is properly tuned and pitched, the singer becomes rather nervous. I know some very capable singers who can sing splendidly before an audience, but when it comes to getting their voice into the phonograph, they are dumb.

I have brought people of great note out to the works, and paid them handsomely for their vocal efforts, only to find, when I came to reproduce these attempts on the phonograph, that the records were utterly worthless.

One must have, indeed, a regular phonograph voice in order to make a good record.

Some people can sing well into a phonograph who could not get up before an audience to save their lives; and, again as I have said, some people can sing before persons, but they cannot perform before a phonograph.

FLOODS NOT AS DESTRUCTIVE AS REPORTED.

As the floods in the Missouri and Mississippi rivers and their tributaries subside, it is gratifying to learn that the loss resulting from them is not nearly so great as was feared, says the Railway Review. The best authorities state that the damage to crops in the flooded districts has really been very slight. The loss of buildings and bridges and the interruption of business, while serious, are by no means as great as has been represented. The railway companies have, of course, been large losers at some points, but the damage has already been largely repaired and business is assuming normal conditions.

GOOD OPENING FOR YOUNG MEN.

As the demand for increased and improved telephone service continues the opportunity for the telephone engineer becomes more and more apparent, says the Electrical Review. Within the past year, at numerous meetings and conventions of engineering bodies, the need of exceptional skill and information to bring success in this field has been emphasized. The telephone engineer must be many kinds of an engineer, and, with the sharp competition which mechanical systems threaten to bring about, the guiding mind of the manual system must be accurate and painstaking, clever and courageous.

POWERFUL STEAM DYNAMO IN GERMANY.

The rapid development of electric central stations in Germany has resulted in the construction of powerful dynamos. The Rhenish-Westphalian Electricity Works at Essen has ordered from the Brown-Bovert Company at Mannheim a steam turbine to furnish power for a dynamo of 5,000 volts and one for 1,600 volts. These two electrical machines will require about 10,000 horse power. The whole apparatus occupies a space less than 9 feet in height and width and about 60 feet in length, says Consul-General Richard Guenther, of Frankfort. The 10,000 horse power turbine has a length of only about 21 feet.

WHAT WILL BE THE NEXT FURNITURE WOOD?

Furniture manufacturers are much concerned over a good wood for furniture making. For years black walnut was the leading wood, and when this became scarce they turned to oak. Now the oak is becoming exhausted, and a wood is wanted which is abundant and capable of taking a good polish.

SHOP NOTES

How a Gasoline Engine Was Made From an Old Steam Engine

W. L. Paul in the American Blacksmith tells row he converted an old steam engine into a gas engine. The description is so interesting we give it in full. He says:

I took an old steam engine with a cylinder 4½ inches in diameter by 12 inches long, and cut off the steam chest and all other projections except the flanges around the ends. I then made a foundation by bending a piece of flat iron ½ by 2 inches edgeways to form a support for the engine. My next step was to take two pieces of flat iron, ⅜ by 6 inches by 10 inches long, and bend it to fit the outside of the cylinder. Feet were now made to one end, and the other end dove-tailed into the flange of the bottom of the cylinder. I bolted the feet to the bed plate or foundation, spreading them far enough apart to allow room for the throw of crank. Turning the engine upside down, I bored four holes through the bed plate and through the bottom flange of the cylinder, put in bolts and screwed them up tight. This gave me a good strong support for my engine cylinder.

The bearings for the crank shaft should be bolted to the bed plate. After forging out my crank shaft of 1½-inch stock, I put it in place and fitted caps to the journals. I next rebored the cylinder This I did by turning a piece of hard wood to fit the cylinder and twenty inches long, fitting a cutter or bit about four inches from one end, and turning it through the cylinder, taking a fine cut, just enough to smooth up the worn places. Taking the old piston, which was two inches thick, I bolted it to a piece of gaspipe five inches long and 4½ inches in diameter. This gave me a piston six inches long. I worked the whole down to fit the inside of the cylinder. I fut four grooves for packing rings, bored a one-inch hole through the piston for cross head pin, made connecting rod and connected all together. The connecting rod should be just long enough so that when all is connected and the piston is at top stroke it will have one-third of the cylinder volume for what is called the combustion chamber.

Taking a piece of galvanized sheet iron, I made a jacket to fit water tight around the flanges of the cylinder. Taking the two heads of the steam engine, I placed them one on top of the other, leaving space enough between the two to allow the water to circulate between, and fitting pieces around the valves and edges to make it water tight. I then bored holes through the bottom, 1½ inches in diameter, for intake and exhaust valves and through the top opposite the intake and exhaust valves for the stem guides. I also bored a hole through the flange of the cylinder, one through the bottom of the cylinder head to match for water circulation, one through the bottom of jacket and another through the top of cylinder head, thus forming a complete water circulation.

The above will give an idea of how I changed a steam to a gasoline engine. The valves and fittings can be arranged to suit the taste and convenience of the builder. I built the above engine with nothing but a post drill as a helping machine.

RELATIVE TRAVEL OF LOCOMOTIVE CRANK-PIN.

A writer in Power finds that the crank-pin of a locomotive having 72-inch drivers and a 26-inch stroke would travel 2 feet 7 9-16 inches farther through space than would the cylinder in five revolutions and he presents a plan for obtaining these results.

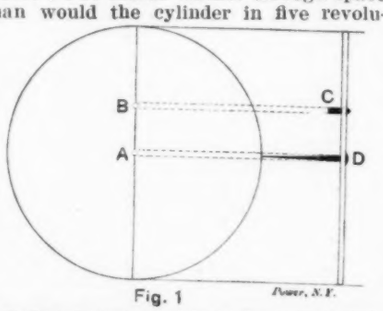


Fig. 1 Power, N.Y.

RELATIVE TRAVEL OF LOCOMOTIVE CRANK-PIN.

Make a piece of cardboard into the shape of a circle, the diameter representing the diameter of the driver to a certain scale. To the same scale set off from the center of the circle, a distance AB equal to the length of the crank, and at B make a hole large enough to insert a pencil lead, as shown at C in the end view, Fig. 1. The insertion of a pin at the center of the circle, as shown at D, enables the rolling of this piece of cardboard in a wood frame, shown in Fig. 2. A line is drawn through the diameter on the cardboard, and the starting point and finishing point of one revolution are marked on the lower horizontal board and transferred to the upright board, at the back of which was placed a piece of plain paper. The pencil thus traced on the paper the path of the crank-pin through space. By measuring the length of this path and comparing it to the length of the path of the center of the cardboard, we have a ratio between the space traveled over by the crank-pin and that of the cylinder. To measure this path, take a strip of light tin, about ½ inch wide and 3 or 4 inches long. This makes a flexible rule that can be bent into the exact shape of the curve, and its length can by this means be accurately measured.

By referring to the scale which was used in constructing the cardboard, we can easily determine what the length of the path decribed by the crank-pin center is.

Fig. 3 shows the form of this path.

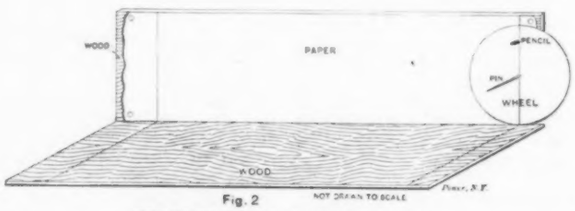


Fig. 2

RELATIVE TRAVEL OF LOCOMOTIVE CRANK-PIN.

DISTANCE TRAVELED BY CRANK PIN 19 FEET 3 INCHES
DISTANCE TRAVELED BY DRIVER IN ONE REVOLUTION — 16 FEET 10½ INCHES
Power, N.Y.
Fig. 3

RELATIVE TRAVEL OF LOCOMOTIVE CRANK-PIN.

HOW TO MAKE MACHINIST'S SOAP.

Castile soap 2 lbs., carbonate potassa ½ lb., hot water 1 pint, aqua ammonia ½ ounce, camphor gum ½ ounce, alcohol ½ ounce. Shave the soap fine and boil with the potassa until thick enough to mold into cakes. Dissolve the camphor with the alcohol, add the ammonia and mix all together and mold into cakes or bars. Scent as desired with a few drops of any of the essential oils.

HARDENING AND TEMPERING STEEL.

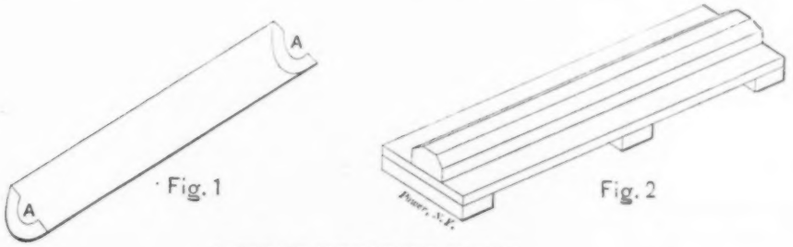
Here is a receipt for hardening and tempering steel, says the Wood-Worker: To one gallon of common fish or whale oil, take one pound each of beeswax and tallow and a quarter-pound resin. Put the above into a kettle and heat till it comes to a boiling point, stirring it once in a while. When all is mixed thoroughly it is ready to use.

To harden in this, heat the steel till the scale rises a little, then immerse it in the oil. When cool, heat over a clean fire till cherry-red in the dark. A little practice will convince any one that the above is one of the best, if not the best, compositions for hardening steel tools for use in cutting iron or wood, or even steel. Care must be used as to the amount of resin in the oil, as the resin hardens the steel, whereas beeswax and tallow toughen it. If a person prefers to temper in daylight, clean the steel or tool, polish it, and draw to a deep straw color, if for cutting iron or steel, and purple if for wood-cutting tools, such as plane irons, cutters, etc.

With the above composition a lower temper can be had for wood-cutting tools than with any other composition I have ever tried, and I have tried several.

CHEAP AND SERVICEABLE PIPE COVERING.

A cheap but highly serviceable covering for steam pipes, especially for those of a smaller size, is a mixture of sawdust, rye flour and molasses in these properties: 1 bushel pine sawdust, 10 pounds rye, 1 quart molasses, according to a writer in Power, who tells how he applied it.



FORMS FOR MOLDING PIPE COVERING.

The flour was mixed with the dry sawdust and the molasses with about a gallon of warm water. The mixture of molasses and water was then sprinkled into the sawdust and flour, stirring to mix as well as possible; more water was then added to thoroughly swell the sawdust, and the mass was ready to be molded.

The forms were very inexpensive. Fig. 1 shows the form. This was of tin, about 2 feet long, and allowed for one inch of sawdust around the pipe. Fig. 2 is of wood, the same length as the form and of ½-inch pine, with cleats at each end and in the middle. A piece of wood of a semi-octagon shape and conforming to the size of the pipe was nailed lengthways of the board; this last stick was smoothed and coated with oil.

The tin mold was filled with the sawdust mixture, as high as the holes A A, when a stick of the same shape as the semi-octagon of the board was laid on, and the sawdust tamped under and around it, bringing the whole up to the level of the top, where it was swept off smooth with a straight-edge. The octagon stick was then pulled out, and the board (Fig.. 2) was inverted over the mold; the whole was then turned over and the tin form removed, leaving the sawdust on the board ready for the oven. A small steam oven was used, drying rather than baking the mixture, which came out very strong with no tendency to crumble.

After baking, the covering was mounted in pairs by pasting a covering of cheese cloth over them and leaving a flap to be pasted down later. In order to prevent any accident from fire, a layer of asbestos paper about 1-16 inch in thickness and 6 inches wide was wrapped around the pipe, the laps at the joints being fastened with wire. The covering was then put on and the flaps pasted down and secured with wire. Ground cork and asbestos were used to cover the fittings. The cost of materials for this covering was about $5 per 100 square feet of pipe covered.

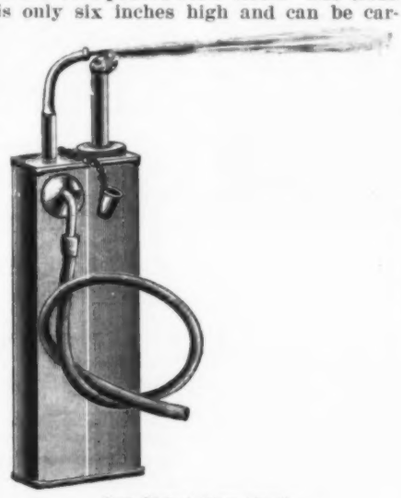
In England where automatic coupling of cars is yet unknown, 150,000 railway employes are killed or injured in ten years in making couplings. These figures are according to the railways on returns to the Board of Trade.

WELDING METALS TO FORM PLATED METAL.

A German process relates to the welding of metals to form plated metal. The surface of each of the metallic bodies to be welded is cleaned and aluminum applied by rubbing the surface with brushes or rollers of aluminum wire or sheets, or with solid aluminum, either by hand or suitable machinery. The two prepared surfaces are then placed together with a thin sheet of aluminum between them, and heated and pressed together to form a weld. The thin coating of aluminum prevents oxidation of the plates during heating and prevents the entry of aluminum from the the sheet into the bodies. If the metal to be welded is aluminum, the thin coating is, of course, dispensed with. In forming plated metal sheets, thick sheets or ingots are first welded together, then rolled down. Plated wire may be formed by plating a thick body in a similar manner and drawing it down to the desired size.

VEST POCKET BLOW TORCH.

One of the handiest devices ever made for electricians, plumbers, jewelers, dentists, painters and the amateur worker, is the vest pocket blow torch. The torch is only six inches high and can be carried in the pocket, and being finished in nickel makes a fine appearance. Its working qualities are as good as its looks, producing an intense heat, and using gasoline instead of alcohol costs only one-third as much to operate. It is perfectly safe as no liuid gasoline is carried in torch which is filled with an absorbent material which is saturated with gasoline. It is made by the Quadridga Manufacturing Co., 18 South Canal Street, Chicago.

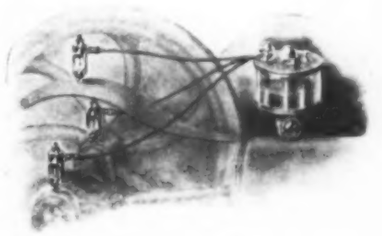


Vest Pocket Blow Torch

MULTIPLEX SYSTEM OF OILING.

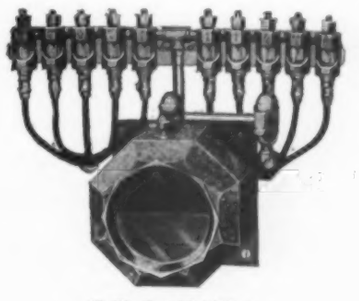
The multitude of automobiles which are being built, and the constantly increasing number of uses to which motor vehicles are being put, have interested the inventive genius of the best mechanical engineers. As fast as a fault developed some bright mind conceived a cure, and so it naturally came about that where many parts required oiling in order to work properly, a means was found to supply lubrication without stopping every few miles and getting out an oil can.

Probably no one other improvement has done more to make a trip enjoyable than the system of automatic lubrication made by the Automatic Lubricator Co. of Chicago. By this arrangement a quantity of oil, sufficient for an entire day's run, is kept in a reservoir. From this reservoir small pipes lead to the various parts to be oiled. With each pipe (and there may be as many as desired) there is a sight feed, so the operator can tell at a glance just how much one is going to each part, and can increase or decrease the flow of any one or all, at will. A novel feature is that when the engine stops all flow of oil automatically ceases. The system can be used as a vacuum or pressure oiler. The cuts give an excellent idea of the system.

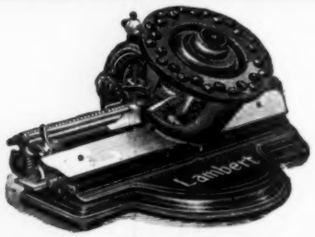


Multi Simplex

The Spider Multiplex



Bull's Eye Multiplex



Your Future Success

Depends upon the manner in which you conduct your business

USE A TYPEWRITER

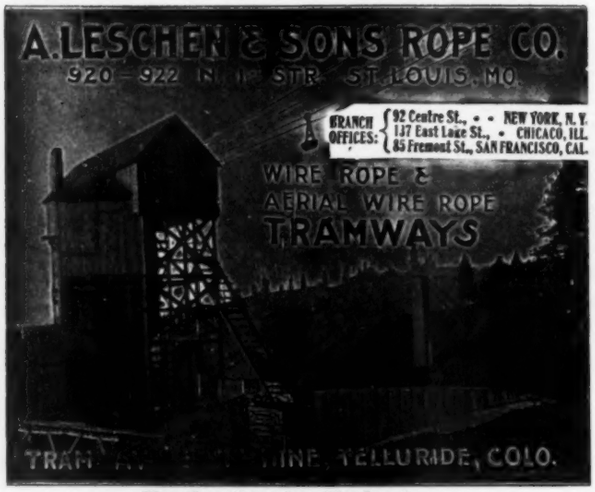
But don't let some smooth agent sell you one for $100 when you can buy one JUST AS GOOD FOR $20.

Portable, speedy, durable and fully guaranteed.
Over 40,000 sold in three years. Call or write.

LAMBERT TYPEWRITER CO.,

86 La Salle St., Chicago.

NEW YORK. • SAN FRANCISCO. • • LONDON


A. LESCHEN & SONS ROPE CO.
920 - 922 N. 1ST STR. ST. LOUIS, MO.
BRANCH OFFICES: 92 Centre St., • • NEW YORK, N. Y.
137 East Lake St., • CHICAGO, ILL.
85 Fremont St., SAN FRANCISCO, CAL.
WIRE ROPE &
AERIAL WIRE ROPE
TRAMWAYS
TELLURIDE, COLO.

Mention Popular Mechanics.

CAUSE OF "MUSICAL" SAND.

Many persons who live within sight and sound of "singing" or "sonorous" sands are ignorant of the causes that give to the sand its musical qualities. "Singing" sand, as it is familiarly known, is different from ordinary sand in that it is composed of round, highly polished grains which are more or less uniform in size. These grains are free from admixture of any kind and from any foreign substance adhering to them. The roundness of the grains allows them to move easily and it is the friction of the grains moving and rubbing against each other that causes the sound, which can be heard at times for a considerable distance. Nearly all the notes in the musical scale are produced by the sand. Upon the amount of sand in vibratory motion depends the shrillness or lowness of the tones, the greater the amount of sand moving the lower the tone. When water or any foreign substance is mixed with the "musical" sand, it fails to produce sound.

"Musical" sand is of very common occurrence, and is found in many countries. In America bodies of it exist in Maine, Massachusetts, New Hampshire, Rhode Island, New York, New Jersey, Virginia, North Carolina, South Carolina, Michigan, Wisconsin and Nevada.

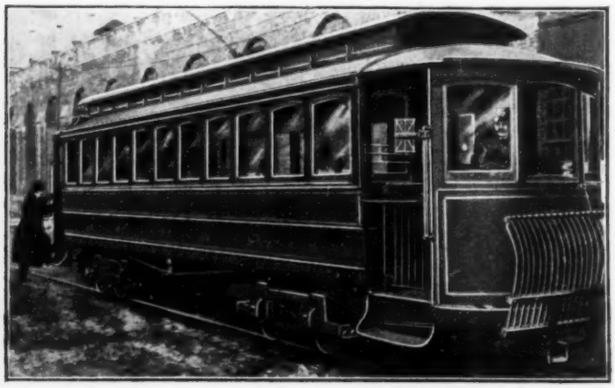
SIMPLE DEVICE TO PREVENT ACCIDENTS.

More street car accidents happen to people in getting on and off the cars than from all other causes combined. Since the street car companies have gone to using such long cars it is very difficult for the motorman to look back and see what the

Mirror Enables Conductor to See to the Rear of His Car

passengers may be doing, and this often accounts for the car starting up before the person is fairly on the ground.

H. P. Brown, of New York City, has invented a very practical device which makes it possible for the motorman to see



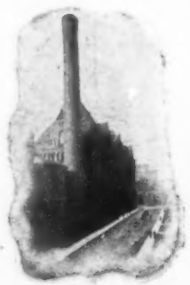
Motorman Watching Passenger Board Car

what is going on at the rear platform by simply turning his head a very little. A mirror projecting from the corner of the car tells the whole story.

A PROBLEM IN HEATING.

Recently a large heating firm was asked to heat with overhead pipes in a peculiar manner, a machine shop 1,100 feet long, 250 feet wide and 82 feet high. The proposition was to heat one-half of this building and leave the other half unheated. The idea was conceived that if a partition were erected, about twelve feet in height, across the middle of the building, that the heated air could be brought down to the zone which it was desired to heat, which was not over eight feet above the floor. It was thought that in this manner the air might be confined in that space without much effect upon the rest of the building.

Accordingly the apparatus was arranged under the landing platforms of the gallery which surrounds the shop, to be out of the way of the cranes. Pipes were carried along beneath the runway of the cranes and branches were brought down on the posts to discharge the air towards the floor, the outlet being in the form of a Y, which was adjustable. The result was as expected, the difference in temperature between the two sides of the partition being almost as great as between the heated portion and out-doors. The result was due to the fact that the air was brought down and continually pressed down into the space which it was desired to heat.



Main Building, Armour Institute of Technology.

ENGINEERING

WITH NATURAL APTITUDE
AND APPLICATION YOU CAN

Master Engineering by Mail

We offer comprehensive courses—20 complete courses in Mechanical, Electrical, Stationary, Locomotive, Civil, Marine and Sanitary Engineering; Architecture, Sheet Metal Work and Textile Manufacturing, and 40 short Engineering Courses including Shop Practice, Refrigeration, Mechanical and Perspective Drawing, Telephony, Telegraphy, Etc.

INSTRUCTION IS UNDER THE DIRECTION OF MEMBERS OF THE FACULTY OF THE ARMOUR INSTITUTE OF TECHNOLOGY.

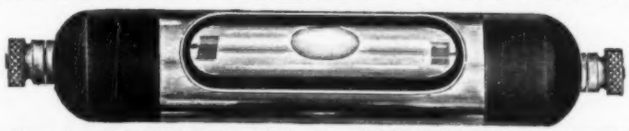
In addition to their regular instruction papers, students in full Engineering Courses are furnished a technical Reference Library (in 10 volumes) as a help in their studies.

WRITE TODAY FOR CATALOGUE GIVING FULL INFORMATION
OUR TUITION FEES WILL BE INCREASED JULY 15, 1903

American School of Correspondence

Room 108 A
At Armour Institute of Technology, - - Chicago, Ill.

MANHATTAN POLARITY INDICATOR



The Newest and Best Indicator Made for BATTERY OR DYNAMO CURRENT

PRICE 75 CENTS EACH

Catalogue No. 16 (just out) describes it and hundreds of other Novelties. Mailed on application

MANHATTAN ELECTRICAL SUPPLY CO.

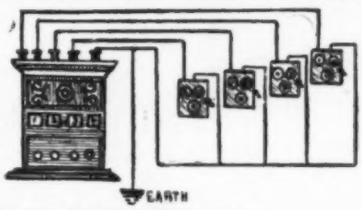
32 Cortlandt St., NEW YORK 186-188 Fifth Ave., CHICAGO

FARR TELEPHONE & CONSTRUCTON SUPPLY CO.

118 & 120 W. Jackson Boul.
CHICAGO, ILL.

Guaranteed Telephones For Everybody

WE WANT YOUR ORDER



HIGH GRADE TELEPHONES AND TELEPHONE SUPPLIES

Telephones for Short Private Lines $2.75 to $6.00 Each.
Telephones for Buildings and Factories $2.75 to $8.00 Each.
Telephones for Exchanges and Toll Lines $5.25 to $14.00 Each.
Batteries, Wire, Cross Arms, Pins, Glass Insulators Guaranteed.

SEND FOR CATALOG B, NO. 16. SENT FREE

ELECTRIC LIGHT PLANTS FOR FACTORIES

Make your own light for factory, residence or city, and save money. Largest stock in the U. S. of second-hand **DYNAMOS** and **MOTORS**, and every one thoroughly rebuilt and tested. All wearing parts new; every machine guaranteed to do perfect work. Our stock includes hundreds of machines from 25 up to 10,000 lights, actually good as new, at a **SAVING OF 25 TO 40 PER CENT.** Most of these machines were replaced by much larger. Also have all necessary instruments, switch boards, &c., &c. Emergency repairs by experts; telegraph orders filled instantly; machines rented; plants installed. Do not purchase until you get our prices and guarantee.

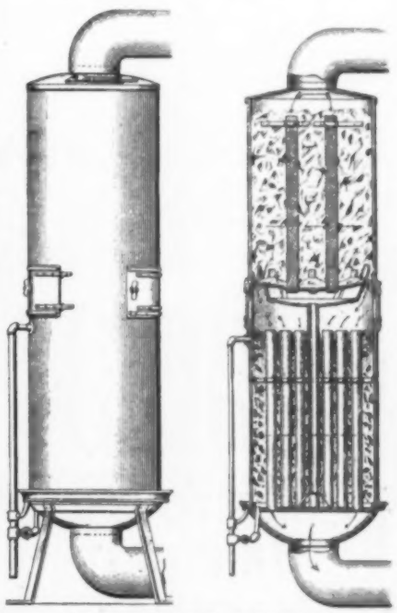
GUARANTEE ELECTRIC CO.

153-159 SOUTH CLINTON ST. CHICAGO

A NEW "COOLING STOVE."

An apparatus for cooling the air, in fact, a cooling stove, has been invented by Prof. Willis L. Moore, chief of the government weather bureau. The fuel used in this new "stove" is broken ice. The parts of the apparatus are within a cylinder composed of heat conducting material. A horizontal partition, having openings along its edge, divides the interior into two chambers. Cracked ice is placed in the upper chamber and the air is conducted through the ice and the partition into the lower chamber by means of woven-wire tubes, which prevent the broken pieces of ice from solidifying and thus stopping the passage of the air.

In the lower chamber is placed finely broken ice, mixed with salt which lowers its melting point and makes its temperature lower than the upper chamber. At the bottom are a number of thin



Exterior and Interior of Cooling Stove

metal pipes which extend above the ice level. These complete the circulation of the air. The principle of the apparatus lies in the fact that cold air being heavier than warm air, falls down through the tubes through the colder lower chamber, establishing a current which is conducted out into the room by a large tube, seen at the right of the drawing. Water pans are placed so as to catch the dripping water.

It is claimed for this invention that it not only reduces the temperature of a room but that it dries the air by condensing the moisture against the sides of the cylinder and that it purifies the air by absorbing the dust in the ice and salt.

All the seven islands of Hawaii are connected by wireless telegraphy.

John Foster Fraser, British author, in his late work entitled "America at Work," says: "The United States Postoffice is as slow as that of Russia. The thing beneath contempt is the telegraph system of the United States."

STEELO

HARDENS AND TOUGHENS IRON, IMPROVES STEEL AND PREVENTS RUST

STEELO COMPANY, 403 EAST 23d ST. NEW YORK, U. S. A.

CHANNELLENE

GRAPHITE OILS

Engineers write us, it will pay you.

New invention, saves big money. Investigate!

IN EVERY DROP!

MONARCH MFG. CO.

COUNCIL BLUFFS, IA.
TOLEDO, OHIO

WOOD or METAL Workers

Without Steam Power should use our Foot and Hand Power Machinery. Send for Catalogues
A—Wood-working Machinery,
B—Lathes, etc.

SENECA FALLS MFG. CO.
692 Water St., Seneca Falls, N.Y.

COLORADO

The delightful country of health-giving, dry air and inspiring scenery is the ideal place for a

Summer Vacation

A country perfectly suited for rest, recreation or sport, abounding in good hotels and boarding places adapted to any man's means. Excursion tickets will be sold at very low rates. Only one night en route from Chicago.

Chicago, Union Pacific and North-Western Line

Illustrated booklets on application at your nearest ticket agent or address

W. B. KNISKERN,
Passenger Traffic Manager C. & N.-W. RY.,
C62 22 Fifth Ave., CHICAGO.

PORTABLE ELECTRIC MOTORS.

An English firm are making portable electric motors mounted on a sort of wheelbarrow, which can be moved to any part of a shop where temporary power is wanted. The plan, of course, involves electric wires for supplying current being strung about the building, to which the motor can be connected.

THE WEAKER SEX.

(At the field day exercises of the Lake View high school, Chicago, the prizes for running high jump, broad jump, 100 yard dash and other athletic feats were won by the girls.)

Father's in the kitchen, with his fingers in the dough;
Willie's in the parlor, practicing his do, sol, do;
Henry's at the tailor's, trying on his Sunday pants—
Mother's with our sisters and our cousins and our aunts.
Mother's jumping hurdles with a dumb bell in each hand;
Lulu's in the ball team, and she never yet has "fanned."
Sadie's playing football, and she says its her delight,
When the other ladies break the game up with a fight.
Molly puts the hammer, and the way the hammer flies
Shows that she's entitled to the plaudits and the prize.
Willie would go walking, but he might acquire some tan—
That would mar the beauty of the winsome little man.
Julius worries father—why the boy would like to play
With the girls at marbles! He has often run away.
Father chided Julius when his hair lost all its curl—
Said it was unmanly to be acting like a girl.
Father's awful patient, but you'd think his heart would break
When ma says his coffee's not like her pa used to make.

SHOE-POLISHING MACHINE.

A Canadian woman has designed a machine to remove the dust and mud from shoes which have become soiled after a recent shine, thus saving the larger expense of a new shine when it is really not needed.

In action the wearer of the shoes places one foot on the central plate, depressing it until the shoe is forced into the soft brushes, the plate meantime moving the lever, which closes the electric circuit and starts the motor. As the brushes begin to revolve the shoe is moved from side to side, forward and backward, once or twice, presenting the entire surface of the leather to the brushes, the whole operation requiring only a moment's time.

Canadian Woman's Invention

There are colored persons going the rounds who make a business of suing railroads, sleeping car companies and hotels for not according them the same rights and privileges as white persons.

Stevens

RIFLES ARE FAMOUS

For their accuracy and durability.

Some of our popular models are:

"STEVENS-MAYNARD, JR." at $3.00
"CRACK SHOT" . . at 4.00
"FAVORITE" No. 17 . at 6.00

We make SHOTGUNS and PISTOLS also. If your dealer does not carry STEVENS FIREARMS do not accept some other gun of questionable accuracy, but send to us. We'll sell you direct from factory, express prepaid, on receipt of price.

Send for catalog describing complete line and containing valuable information about rifles, ammunition, etc.

J. Stevens Arms & Tool Co.,
40 Main Street,
CHICOPEE FALLS, MASS.

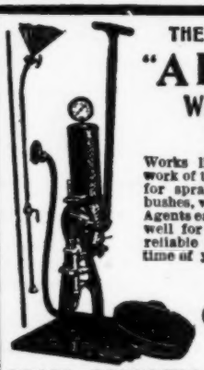
Machine Cut Wood Gear Patterns TO ORDER.

We can make your gears better and deliver them quicker than you can in your own shop.

SPUR, BEVEL OR SPIRAL

Wood Pattern Work in all its Branches. Write

CHICAGO PATTERN WORKS, Chicago, Ill.



THE ONLY ORIGINAL

"ALLIER" Whitewashing Machine

Works like magic; will do the work of ten men. Just the thing for spraying fruit trees, berry bushes, vines, plants, shrubs, etc. Agents earn big money. We pay well for a part of the time of reliable men. Now is the best time of year.

MANUFACTURED SOLELY BY

Chas. L. Bastian Mfg. Co.

BRASS FOUNDERS AND FINISHERS
76-82 ILLINOIS STREET, CHICAGO

Estimates furnished on BRASS CASTINGS of every description .. .. Mention Popular Mechanics

ELECTRICAL NOVELTIES..

½ H. P. Gas Engine

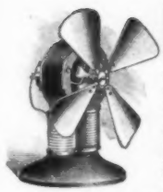
Supplies of all Kinds for Amateurs and Professionals.

Small Dynamos and Motors, Castings and finished parts for complete construction. Telegraph and Telephone Apparatus. Experimental Apparatus, Electric Sign Letters.

GAS AND GASOLINE ENGINES

½ H. P. up. Rough Castings to build. Marine Gasoline Engines 1 to 4 H. P. Send for Complete Catalogue.

L. W. GILLESPIE, - MARION, INDIANA



KEEP COOL

A 9-in. Electric Fan Motor with batteries and everything complete ready to start $6

Batteries furnish power between 200 and 300 hours of running. Cost $1 to renew. Price $6. Cash with order or $1 with order, balance C. O. D. Money back if not satisfactory.

Agents Wanted.

ACME ELECTRIC CO.

200 So. Clinton St. Chicago, Ill.

Reference: Continental National Bank.

DRAWING INSTRUMENTS

Complete Set In Case $2 to $5 German Silver Highest Grade

ILLUSTRATED CATALOGUE FREE

SHOWING FULL LINE DRAWING MATERIALS. SPECIAL DISCOUNT TO ARCHITECTS-DRAFTSMEN.

INDIANAPOLIS BLUE PRINT CO.

MOTORS and Dynamos for sale at bargain prices. We have a large stock of Dynamos and Motors which have been used a very little. They are as good as new and in perfect condition. Guaranteed in every respect. Write us what you want. We carry all sizes, 1-8 H. P. up.

PIERSON ELECTRIC COMPANY
85 Lake Street

Motor Cycle Engine Castings $7.50

Write us for our latest special offer.

FINISHED MOTORS AND ACCESSORIES

GRAVES MOTOR MFG. CO., St. Paul, Minn.

PATENTS

PROTECT YOUR IDEAS.
Consultation Free.
Fee Dependent on Success.
Established 1864
MILO B. STEVENS & CO.
885 14th St. Washington, D. C

ZAMBESI GEM. Great Discovery. Experts can not detect it from genuine diamond. Costs but one-tenth. In brilliancy and cut it has no equal. Setting solid gold. Write for illustrated catalogue. ROWE & CO., Dept. X, 358 Dearborn St., Chicago, Ill.

TYPEWRITERS ALL MAKES

All the Standard Machines Sold or Rented Anywhere at Half Manufacturers Prices. Shipped with privilege of examination. Send for cats'g Typewriter Emporium, 196 La Salle St., Chicago

PATENTS Write for our "Special Proposition." We procure allowance of PATENT or CHARGE NOTHING for our services. 20 years' experience.
C. C. SHEPHERD, Patent Attorney,
918 F St., N. W., Washington, D. C., Dept. X.

DRAWING STUDENTS NEED THE DRAFTSMAN
25c for 4 months—Cleveland, Ohio

CYRUS W. RICE
PATENT LAWYER
Prompt and Careful Attention to Soliciting Patents
1211 Ashland Block, CHICAGO
Bank References. Branch Offices: Washington, D. C.

10 VOLT, 1-8 H. P.
Battery Motors
$5 00 EACH
WALSH'S SONS & COMPANY
250 Washington St., Newark, N. J.

A HOME-MADE COOKING-BOX.

A cooking-box, which can be made at home with little cost, with which an entire meal can be cooked by means of a single lamp, and which requires no attention from the housewife after the articles are put in to cook, except to take them out when done, is a device described by The Ohio Farmer.

The box is made of pine or whitened plank, one or two inches thick. It should be lined with tin and is better when covered also with tin. The box should be placed on a metal-top table, to which it may be hinged. A 2½-inch hole in middle of the table top affords space for the lamp chimney. A double tube is open at the bottom of the box over the lamp chimney and over the hole in the metallic-top table. This tube may be arranged so that the openings may be merged for quick cooking or closed al-

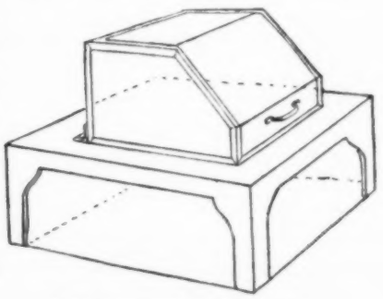


Fig 1—COOKING BOX—Perspective.

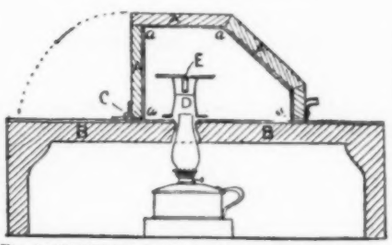


Fig. 2—COOKING BOX—Sectional View; A, A, A, oven; a, a, a, hottest places; B, B, metal table; C, hinge; D, double tube; E, openings.

together for slow cooking. The hottest place in the box is directly over the lamp and the next hottest places around the tube.

A convenient size for the box is 14 inches square, with a slant top which allows a tall vessel to be placed over the lamp and still gives room for vessels under the slant which may be cooked slowly.

FRANKLIN INSTITUTE'S OFFER.

The Franklin institute again announces its offer of $1,000 to any resident of North America, including the West Indies and Mexico, who shall determine by experiment whether all rays of light, and other physical rays, are or are not, transmitted with the same velocity. The money for the offer was deposited with the institute by Uriah A. Boyden in 1859. Those who desire further information regarding the award should address the Franklin Institute, Philadelphia.

Three times as much freight passed the "Soo" last year as passed through the Suez canal.

We Have For Sale

a few choice tracts of land on the Isthmus of Tehuantepec, part of which fronts on the National Tehuantepec Railroad, and all of it within a short distance of the railroad.

In this vicinity are located over fifty plantations owned and being cultivated by Americans, among them being the well-known "DOS RIOS" and "MEXICAN MUTUAL"; these lands are suited for the cultivation of rubber, coffee, cocoa, sugar, vanilla, fruits of nearly every variety, and are especially well adapted for the raising of cattle, horses and mules. For particulars call or address

MEXICAN INVESTMENT COMPANY
No. 160 WASHINGTON STREET, CHICAGO

JUST WHAT EVERY YOUNG ELECTRICIAN WANTS.

THE MODEL DYNAMO-MOTOR.

Will Decompose Water, Do Electro Plating, Light Incandescent Lamps, Run Machinery, etc.

☞ *Send 2c. stamp for illustrated catalogue.*

Elbridge Electrical Mfg. Co., Elbridge, N. Y., U. S. A.

%%%%%%%%%%%%%%
% **Everything at a Discount.** %
% Private Line Telephones.....$4.00 %
% Learner's Telegraph Key and Sounder.....$1.50 %
% Carlson Battery complete $0 25. Dry Battery $ .18 %
% Battery Fan Motor Outfit.....$3 00 %
% Call Bell Outfit complete.....$ .85 %
% Stock list free. Open evenings. %
% C. M. TURNQUIST, 442 W. Van Buren St., Chicago %
%%%%%%%%%%%%%%

It Will Pay You to Write Us About Your 1903 Wheel

"D. and J." HANGERS are Absolutely the BEST. WHY?

They are Mechanically Correct, Accurately Ground, Lightest, Nearest Dust and Water Proof, Neatest in Appearance, and they are used by the best Manufacturers and ridden by the best Professionals and Amateurs of America. If you want the agency for a good wheel write us and mention Popular Mechanics. PARK CITY MFG. CO., Inc., Jackson Blvd. and Clinton St., Chicago.

BOOK BINDING

For $1.00 per volume we will bind Popular Mechanics in one-half leather, cloth joints, leather corners, cloth sides. This price applies also to other mechanical journals of a similar size.

Our Strong Point is magazine binding. Send your books or send a postal to

The Book Shop Bindery

Phone Main 4421 171 Madison Street, Chicago, Illinois

OUR ROTARY MEASURE

The fastest all-around measure made. Measures curves of any kind as easily as straight work. Accurate, carried in the vest pocket, lasts a life time. As simple as a rule. In fact, so simple anyone can use it. Praised by all who know its merits as an ideal measure for the factory, office or home. Says one: "I would not be without it for $50." Write today for free illust'd circular.

Steckenreiter Mfg. Co.
102 Lake St., Chicago, Ill

METAL PARTS

for any machine or device manufactured to order in any quantity. Models, Mechanical or Electrical, made from your drawings.

Best facilities, prompt service, terms reasonable.

SPIES ELECTRIC CO.
91 W. Van Buren St., Chicago

AUTOMOBILE MATERIAL

For Building and Repairing all Kinds of

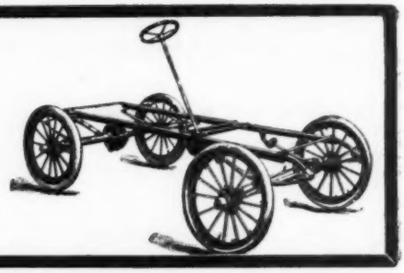
Gasoline and Steam Vehicles, Motor Cycles, Etc.

GASOLINE ENGINES FROM 1 1-4 H. P. TO 80 H. P.

Transmission Gears, Running Gears, Wheels, Axles, Differential Gears, Coils, Batteries, and in fact everything necessary for automobiles, also caps, coats and all accessories

SEND FOR 1903 CATALOGUE AND MENTION THIS PAPER.

THE P. J. DASEY COMPANY, - - - 21 La Salle St., Chicago



OUR GASOLINE ENGINES

1 to 60 H. P.,

Are so simple and perfect in construction that a boy can start them Monday morning and they will run right on by themselves for a whole week, night and day, without another touch or any attention whatever. Do not get out of order. Cost only a few cents a day. No sparks or danger from fire. Just the thing for cheap power for Machine shops or Residence, Electric Light Plants, etc. We have them portable by hand or mounted on wheels for any kind of work on the farm, sawing wood, pumping, etc. We also carry all sizes Gasoline Marine and Automobile Engines. Write for catalog and price.

Cavanaugh & Darley

25 West Randolph St. .. .. .. CHICAGO

CRANE VALVES

ESTABLISHED 1855

"Want" and "For Sale" Ads. 2 cents per word, payable in advance. Replies may be sent to a number, care Popular Mechanics, and will be forwarded promptly without extra charge.

FOR SALE.

FOR SALE AT A BARGAIN—250 shares of Platteville Exploration and Development Stock, Platteville, Wis. For sale way below par. Make me an offer. Address 748 Popular Mechanics, Chicago.

WRITE US YOUR WANTS if in need of power, we build Boilers, Pumps, Steam, Gas and Gasoline Engines from ½ H. P. up. Martin Mfg. Co., 180 W. Madison St., Chicago, Ill.

FOR SALE or Rent; general store building; well located; on two railroads. Address M. J. Tietjens, Mason City, Iowa.

FOR SALE—Six horse power Lewis gasoline engine cheap for cash. S. A. Zapp, Emerson, Neb.

IF YOU WANT a Marine or Stationary Gasoline Engine, and don't know where to get it, write to Popular Mechanics.

FOR SALE—About two car loads of Black Walnut stumps, finest quality and close to railroad. Bernard Browning, Gaston, Ind.

UNUSUAL BUSINESS OPPORTUNITY—Cash sales $200 daily; clean fresh stock of groceries invoices $5,000. Only five grocery stores in growing city of 10,000. Trade includes finest people in the city; business increasing all the time. Satisfactory reason for selling. Address 743 Popular Mechanics.

FOR SALE CHEAP—Scientific and Plain Tool Tempering to a standard with Toy's Colored Charts A and B in Oil, Water or Tallow and a New Treatise on all the New Steels made, with 75 New Methods for Forging, Welding and Self-Hardening with ten Welding Compounds for same. Also Thermite Welding explained and welding compound to weld same. All the above for one dollar. Samples free. Forty years a factory steel worker. W. M. Toy, Sidney, Ohio.

CHARTERS.

INCORPORATE YOUR BUSINESS—Charters procured under South Dakota laws for a few dollars. Write for corporation laws, blanks, bylaws and forms, free, to Philip Lawrence, late Assistant Secretary of State, Huron, Beadle Co., South Dakota.

WANTED.

100 AGENTS WANTED—Something new. Send 2-cent stamp for reply. A snap for agents. A. B. Farmwald, Nappanee, Ind.

BUSINESS CHANCES.

ANYTHING YOU WANT and don't know where to get it, write Popular Mechanics, Chicago.

GOOD PAYING JEWELRY and Optical business in a growing Southern college town of about 2,000 pop. Will furnish further information and photographs of store on application. Address "Jeweler," Box 92, Chapel Hill, N. C.

DO YOU WANT TO EARN a Motor Bicycle free? Address without delay 735 Popular Mechanics.

AUTOMOBILES.

FOR SALE—Reading steam automobile; running order; good tires. Price $200 if sold at once. F. B. Catlin, Winsted, Conn.

WANTED—An automobile, gasoline, Oldsmobile preferred, will consider any reliable make, '93 model, artillery wheels, must be in perfect condition, for which I will trade stock in one of the best, most promising gold mines in California; stock of which recently doubled in price and will pay large dividends in the near future. If you have what I want and mean business, write full particulars, when I will send prospectus of mine. Address Box 28, Lincoln, Calif.

MISCELLANEOUS.

IF YOU WANT ANY TOOL for any trade and don't know where to get it write to Popular Mechanics, Chicago.

LET ME SELL YOUR PATENT. I HAVE BUYERS WAITING. CHARLES A. SCOTT, GRANITE BLDG., ROCHESTER, N. Y.

A WONDER—"THE WIZARD TOP." An unequaled mechanical marvel and the greatest trick top ever invented. Will spin for six minutes in any position and perform over thirty tricks. Interests everyone with its variety of mysterious and puzzling antics. Substantially made of the best extra heavy cold-rolled sheet steel and mechanically constructed. By mail to any address postpaid only 25 cents. Los Gatos Novelty Co., Journal building, Chicago. The Wizard sells on sight; unusual opportunity for agents.

GLOGAU'S ALCOHOL - GAS STOVE (Made in Germany)—Far ahead of any other alcohol stove on the market; consumes only two cents worth of alcohol an hour. Odorless, wickless, will boil a quart of water in nine minutes; makes its own gas from either Wood or Grain Alcohol; cannot explode; an invaluable accessory to camp, kitchen or sick-room. Prepaid, only $1.00. Los Gatos Novelty Co., Journal Bldg., Chicago.

STOCK COMPANIES INCORPORATED AND FINANCED. NEW YORK CORRESPONDENTS. CHARLES A. SCOTT, ROCHESTER, N. Y.

INDUCTION COILS and COIL MAKING. Just what you want; tells how to make Induction, Gas Engine, Spark, Bath, X-Ray, Medical and Automobile Coils; also contains tables of American wires and gauges. Fully illustrated. By mail, prepaid $1.00. Popular Mechanics, Chicago.

ENGINEERING INSTRUCTION FREE.—Any bright young man in any town or city of 5,000 or more can earn a complete course of engineering in a short time with only a few hours work each day. The finest course of enginering instruction in the country, and absolutely free. For full particulars address 746 Popular Mechanics.

SPECIALTY MANUFACTURING.

MANUFACTURERS OF PATENT ARTICLES, dies, metal stamping, screw machine work, hardware specialties, special machinery and tools. Quadriga Manufacturing Company, 18 South Canal St., Chicago.

One man in each good sized shop can, at noon and without any expense earn a set of the

MECHANICAL LIBRARY FREE

It is the best work of the kind ever published and like Popular Mechanics, is "written so you can understand it." Contains 10 vols., 4,000 pages, 2,000 illustrations. Just out. Do you want to know all about it? Then write Popular Mechanics.

IF YOU WANT TO BUY AN ENGINE, MACHINERY, OR ENGINEERS SUPPLIES OF ANY KIND, WRITE TO POPULAR MECHANICS.

Please mention Popular Mechanics when writing to advertisers.